University of Tripoli Faculty of Engineering Electrical and Electronic Department

Spring 2015 2nd Midterm Exam Solution **Signals & System (EE302)** Date: 28/05/2015

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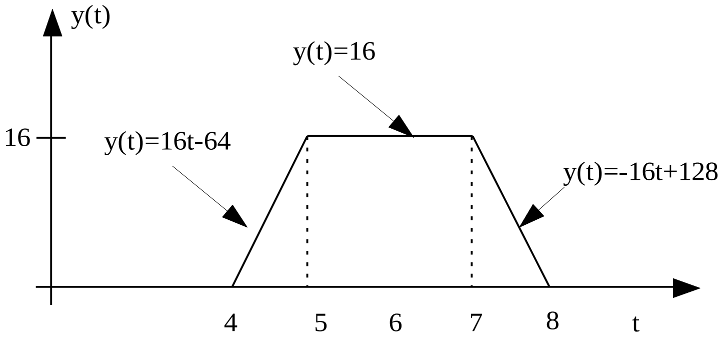
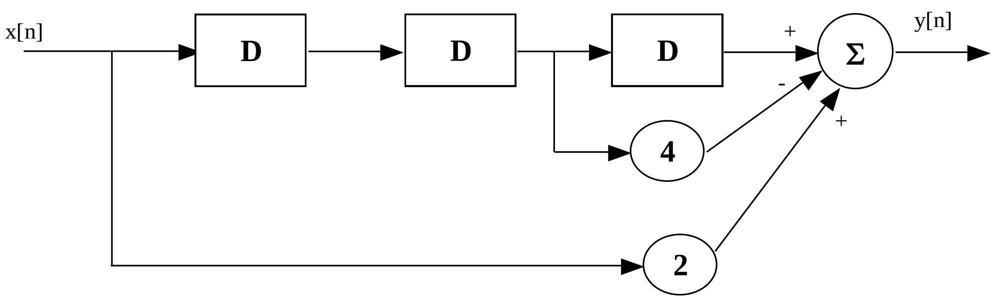
Q1)

[4]



Q2:-

a)



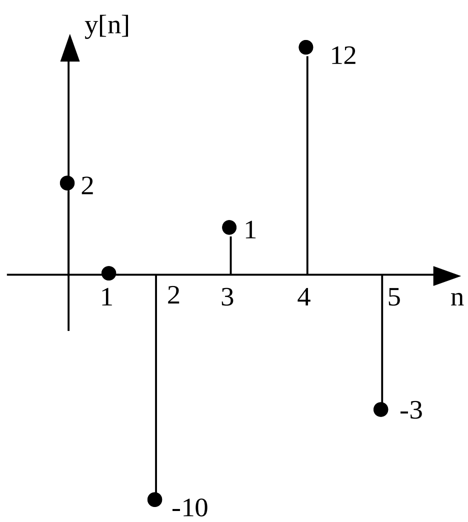
[5]

b)

$$h[n] = 2\delta[n] - 4\delta x[n-2] + \delta[n-3]$$

c)

y[n]=x[n]*h[n]={1,0,-3}*{2,0,-4,1}={2,0,-10,1,12,-3}



Q3 - [4]

a) $3\delta(t-5) \Leftrightarrow 3e^{-5s}$ ROC: all s except s= -∞

b) $2u(t-3) \Leftrightarrow \frac{2e^{-3s}}{s}$ ROC: Re(s)>0

c) $x(t) = 2tu(t+2) \Leftrightarrow 2\left[\frac{e^{2s}}{s^2} - \frac{2e^{2s}}{s}\right]$ ROC: Re(s)>0

d)

$$x(t) = e^{-t}u(t) - e^{-t}u(t-2) = e^{-t}u(t) - e^{-2}e^{-(t-2)}u(t-2)$$

$$X(s) = \frac{1}{s+1} - e^{-2}e^{-2s}\frac{1}{s+1} = \frac{1}{s+2}\left(1 - e^{-2(s+1)}\right) \quad \text{ROC: Re(s)} > -2$$

Q4 –

[7]

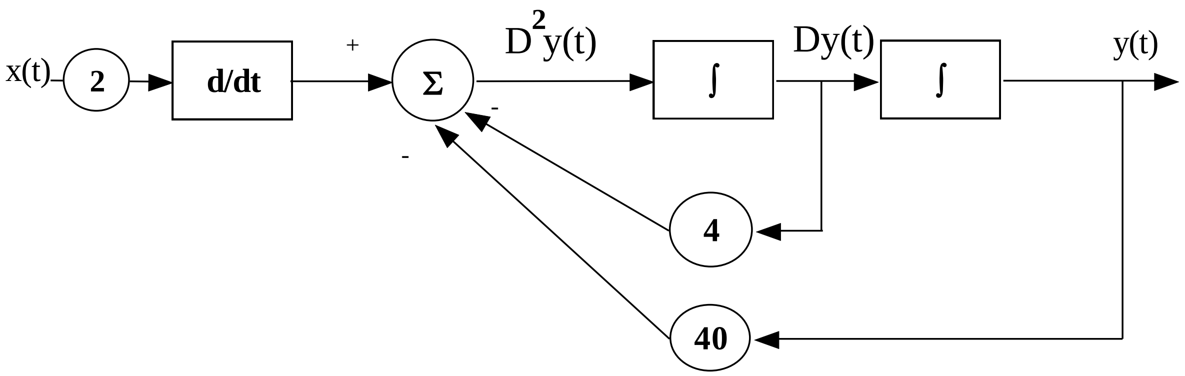
a)

$$x(t) = \frac{1}{2}\frac{dy}{dt} + 2y(t) + 20\int y(\tau)\,d\tau$$

$$\frac{1}{2}D^2y(t) + 2Dy(t) + 20y(t) = Dx(t)$$

$$D^2y(t) = 2Dx(t) - 4Dy(t) - 40y(t)$$

b)



c)

$$D^2y(t) + 4Dy(t) + 40y(t) = 2Dx(t)$$

The impulse response of the function

$$D^2y(t) + 4Dy(t) + 40y(t) = x(t)$$

Can be found using

$$D^2\acute{h}(t) + 4D\acute{h}(t) + 40\acute{h}(t) = \delta(t)$$

The homogeneous solution is given as $\acute{h}(t) = c_1 e^{(-2+6j)t} + c_2 e^{(-2-6j)t}$

With $\acute{h}(0) = 0 \ \ and \ \acute{h}^{(1)}(0) = 1$

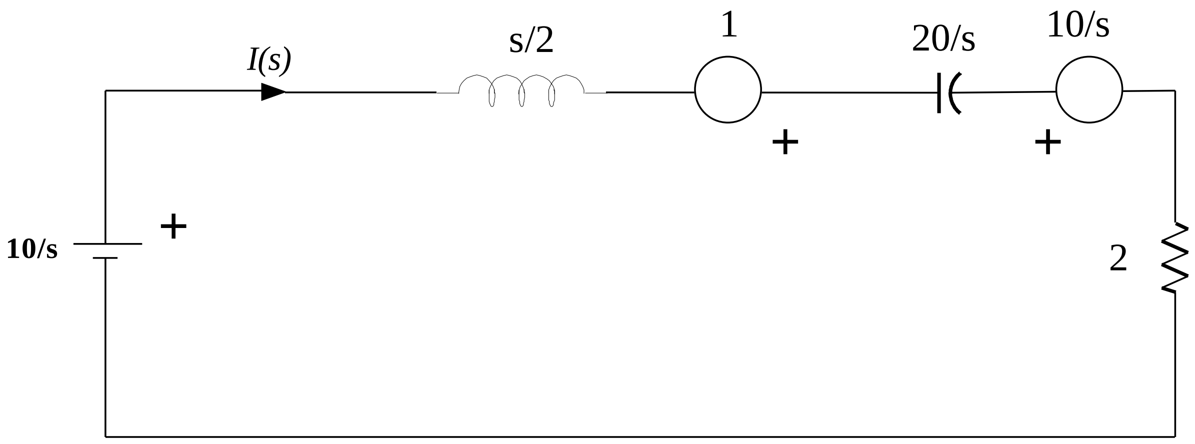
Thus

$$\acute{h}(t) = \frac{-j}{12} e^{(-2+6j)t} + \frac{j}{12} e^{(-2-6j)t}$$

The required impulse response given as $h(t) = 2D\acute{h}(t) = \left[\frac{(6+2j)}{6} e^{(-2+6j)t} + \frac{(6-2j)}{6} e^{(-2-6j)t}\right] u(t)$

d)

$i(0^-)=2$, $v_c(0^-)=10$



$$\frac{1}{2}sI(s) - 1 + 2I(s) + \frac{20}{s}I(s) + \frac{10}{s} = \frac{10}{s}$$

$$I(s) = \frac{2s}{s^2 + 4s + 40} = 2\frac{s+2}{(s+2)^2 + 6^2} - \frac{2}{3}\frac{6}{(s+2)^2 + 6^2}$$

$$i(t) = e^{-2t}(2\cos 6t - \frac{2}{3}\sin 6t)\ u(t)$$